PROJECT SUMMARY

Purpose of the research

The primary objective of the **N**on-**T**hermal **S**anitation by **A**tmospheric **P**ressure **P**lasma (NTSAPP) Phase 2 is to develop and evaluate a fully operational plasma reaction chamber prototype for sanitizing fresh food on long-duration space missions.

Brief description of the research carried out

This effort built upon knowledge gained and lessons learned from the Phase 1 and other ORBITEC plasma development projects. ORBITEC worked with Glasram, LLC, which is a spin-off company from Texas A&M University, and operates out of Texas A&M's Plasma Engineering Research Laboratory (PERL). ORBITEC and Glasram worked together to evaluate the current ORBITEC designs, research the latest available technologies, and utilize the latest plasma system analysis tools.

The ORBITEC team designed, built, and optimized a new prototype power supply and jet reactor.

This power supply and jet reactor design was incorporated into an integrated plasma reaction chamber system prototype. The system prototype operates by drawing air in from outside the system moves the air through five plasma jet reactors. The generated plasma then flows with the air through a rotating food sanitation chamber. The air and plasma flow through a scrubber to break down any harmful components of the air prior to leaving the system and returning to the surrounding environment. This integrated system prototype is capable of sanitizing fresh fruits and vegetables in a matter of minutes, with minimal consumables and byproducts. The system hardware is designed to meet the interface and safety requirements for ISS hardware, which includes EMI emissions requirements.

The antimicrobial efficacy of the integrated system prototype was tested with a number of process gases, food items, and microbes. In addition, ORBITEC evaluated the effect of NTSAPP processing on food items.

Research findings or results

System prototype testing showed that antimicrobial performance was not significantly related to position of the food within the sanitizing chamber. Testing with a number of process gases showed that performance with bottled gases and gas mixtures was not significantly better than performance with lab air as the process gas. Lab air was selected as the process gas for the remainder of antimicrobial testing because it allows the NTSAPP system to operate without pressurized gas lines, and with minimal consumables. All antimicrobial testing showed greater microbial reduction with a fresh flow of lab air than with recirculated lab air.

Tests performed with a fresh flow of lab air on samples of lettuce, tomato, and radish inoculated with E. coli and Salmonella showed the following:

- Ten minutes of sanitizing showed ~3 log reduction of *E. coli* and *Salmonella* on lettuce and tomato and ~2.5 log reduction of *E. coli* and *Salmonella* on radish.
- Fifteen minutes of sanitizing showed ~3.7 log reduction of *E. coli* on lettuce and tomato and ~3.2 log reduction of *E. coli* on radish.
- Fifteen minutes of sanitizing showed ~3.6 log reduction of *Salmonella* on lettuce and tomato and ~3 log reduction of *Salmonella* on radish.

Testing with trained food quality panelists showed that NTSAPP processing has no significant impact on food quality.